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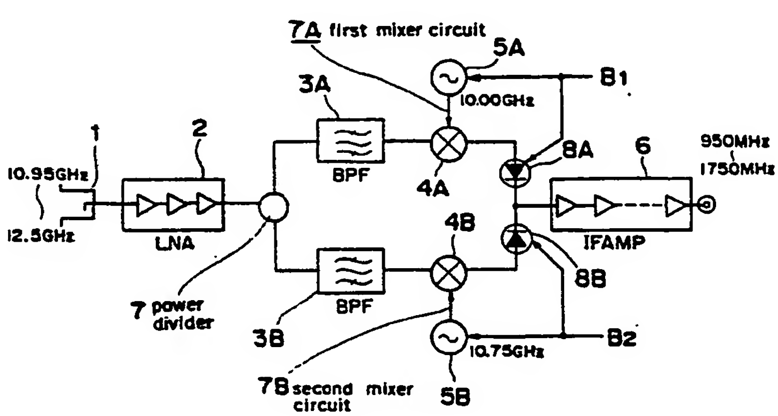
(54) **Outdoor unit low noise converter for satellite broadcast reception use.**

(57) In an outdoor unit low noise converter for satellite broadcast reception use preferably comprising a 2-band LNB converter (LNB: Low Noise Block Downconverter)for receiving two frequency bands, the converter is capable of receiving a plurality of bands by one converter including the same number of terminals by making use of power supply voltages fed via the IF output.

Fig. 1



EP 0 300 173 A2

Outdoor Unit Low Noise Converter for Satellite Broadcast Reception Use

The present invention generally relates to a low noise converter of an outdoor unit for satellite broadcast reception use.

Generally, the satellite broadcasting transmits electromagnetic waves in the range of 10.95 GHz through 12.75 GHz from a stationary satellite over the equator to the ground to effect a broadcasting operation onto wider areas. A parabola antenna of high gain or a plane antenna thereof receives the waves so as to convert them into the signals of 1 GHz band immediately near the antenna. This is because the received signals are required to be transmitted by a cable to an indoor receiver, so that the frequency is made lower to make the signal sufficient in strength. It is a low noise converter (LNB: Low Noise Block Downconverter) that effects the frequency converting operation.

The band width of the waves transmitted from the stationary satellite is normally 500 MHz through 800 MHz, in which the program of the satellite broadcasting of 1 through 24 channels are included. The low noise converter converts all the signals of this band width into the 1 GHz. For example, in the Europe Ku band, 11.7 GHz through 12.5 GHz are inputted, are converted into the signals of 950 MHz through 1750 MHz (800 MHz in band width) as IF signals, and are outputted so that the station is selected by an indoor receiver.

Fig. 7 shows a circuit construction example of the conventional low noise converter. The input signals are amplified through a coaxial waveguide converting portion 1 by a low noise amplifier 2 of GaAs FET 2 through 3 step construction. Then, the received signals are passed into a band passing type filter 3 for preventing image signals or local signals so as to be mixed with an office transmitting signals from an office transmitting oscillator 5 by a mixer 4. They are further amplified by an IF amplifier 6 and are outputted as IF signals.

When the input signals are in the range of 11.7 GHz through 12.5 GHz, the office transmitting signals are 10.75 GHz and are converted into the frequencies of 950 MHz through 1750 MHz as IF signals. Fig. 8 shows a characteristic example of frequency relationship and its band passing type filter 3 in the conventional low noise converter.

In the present invention, the frequencies which the satellite uses for the broadcasting operation are not only 11.7 GHz through 12.5 GHz (for example, the above-described Europe Ku band), but also frequency bands which are different from 10.95 GHz through 11.7 GHz (for example ECS (European Communication Satellite) band) and 12.25 GHz through 12.75 GHz (for example, Authert). Low noise converters adjusted for the frequency band are respectively prepared, so that a low noise converter is required to be selected for cooperation with the satellite to be received. Furthermore, a plurality of antennas and low noise converters are required when a plurality of satellites exist, the frequencies thereof are different respectively, or frequency bands are changed by the operation replacement of the satellites.

When the art of the circuit construction (which is designed to receive the signals of Europe Ku bands 11.7 GHz through 12.5 GHz) is extended as it is so that signals in the range of 10.95 GHz through 12.5 GHz including, for example, the ECS band are tried to be received, the conversion band width of the IF signal becomes 1550 MHz (= 12.5 GHz through 1.95 GHz), so that it is difficult for the indoor receiver to cover the range, thus considerably deteriorating the accuracy of the IF signals.

Also, in 2-band low noise converter (LNB: Low Noise Block Downconverter), so-called 2-band LNB for receiving two frequency bands, a signal for selecting a receiving band is required to be given to the 2-band LNB in order to receive two bands. Conventionally, a band switching input terminal 3, in addition to the IF output terminal 2 of the 2-band LNB1 as shown in Fig. 9, is provided. It is to be noted that in Fig. 9, reference numeral 4 is an input waveguide.

However, the 2-band LNB requires sufficient airtight property for the outdoor use thereof, but is is an obstacle in maintaining of the airtight property to provide a band switching input terminal 3, in addition to an IF output terminal 2, thus resulting in complicated construction.

SUMMARY OF THE INVENTION

Accordingly, an essential object of the present invention is to provide an improved low noise converter which is capable of receiving a plurality of bands by one converter.

Another important object of the present invention is to provide a 2-band LNB which has terminals as many as those of the LNB of one band through placing of power-supply voltages upon the IF output.

For the solution of the conventional problems, the present invention is to provide a low noise converter which has a low-noise amplifier of wider band, a power divider for allotting the output signal of the amplifier to a plurality, a plurality of band passing type filters and mixer circuits provided corresponding respectively allotted signals, and an output selecting circuit for switching the output

signals of each mixer circuit to the after-IF amplifier. Accordingly, in a converter of the above-described construction, input signals including a plurality of bands are amplified by a wide band low noise amplifier and are divided by the power divider. The signals are allotted, thereafter, pass through filters each having a given passing band, and are mixed with office transmitting signals which have been set for each band in the mixer circuit. The output switching to the IF amplifier is effected by an output selecting circuit so that a plurality of bands may be received by one converter, with the band width of the IF signal not being made wider.

Also, the present invention provides a 2-band LNB which has means for switching frequency bands to be received in accordance with the level of the power supply voltage to be fed through the IF signal terminal.

The converter of the above-described construction does not require the band switching input terminal to improve the airtight property, thus simplifying the construction.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of the present invention will become clear from the following description taken in conjunction with the preferred embodiments thereof with reference to the accompanying drawings, in which:

Fig. 1 is a circuit diagram in one embodiment of the present invention;

Fig. 2 is a graph showing the relationship of two bands for receiving operation;

Fig. 3 is a circuit diagram in a second embodiment of the present invention;

Fig. 4 is a circuit diagram showing an application example thereof;

Fig. 5 is an appearance view thereof;

Fig. 6 is a waveform chart thereof;

Fig. 7 is a circuit diagram showing the conventional example;

Fig. 8 is a chart showing the characteristics of the conventional reception frequency relationship and a band passing type filter; and

Fig. 9 is an appearance view showing the convention embodiment.

DETAILED DESCRIPTION OF THE INVENTION

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

(First Embodiment)

The circuit construction in a first embodiment of the present invention is shown in Fig. 1. Also Fig. 2 shows the frequency relation of a plurality of bands to be received. Here, the ECS band of 10.95 GHz through 11.7 GHz and the Europe Ku band of 11.7 GHz through 12.5 GHz, two bands, are switched for reception.

In Fig. 1, the same reference characters are given to the function portions which are the same as those of Fig. 6. The low noise amplifier 2 is widened in band so that the signals of 10.95 GHz through 12.5 GHz may be amplified. An power divider 7 divides the amplified output signal into two for connection to each of a first band passing type filter 3A with, for example, 10.95 GHz through 11.7 GHz being a passing band and, a second band passing type filter 3B with, for example, 11.7 through 12.5 GHz being a passing band. Also, in accordance with it, a first mixer circuit 7A composed of a mixer 4A and an office oscillator 5A of an office transmitting signal of 10.00 GHz is connected with a second mixer circuit 7B composed of a mixer 4B and an office oscillator 5B of an office transmitting signal 10.75 GHz.

The output switching operation into the after IF amplifier 6 is selected by the control of the oscillating operation of the respective office oscillators 5A, 5B with voltages B1, B2 as power supply, and diode switches 8A, 8B connected in series respectively to mixers 4A, 4B. It is to be noted that diode switches 8A, 8B are adapted to turn on, off through the operative cooperation with the controlling operation of the oscillation with the voltages B1, B2 in common.

In the first mixer circuit 7A, the signals of 10.95 GHz through 11.7 GHz which have passed through the first band passing type filter A are converted into the frequencies of 950 MHz through 1700 MHz (750 MHz in band width) because of the above description. In the second mixer circuit 7B, similarly the signals of 11.7 GHz through 12.5 GHz which have passed through the second band passing filter 3B are converted into the frequencies of 950 MHz through 1750 MHz (800 MHz in band width). In this manner, frequencies, if in any band, are selectively outputted into the IF amplifier 6 within the range of 950 MHz through 1750 MHz, with the band width not being made larger and being within the range of 750 MHz through 800 MHz, so that they are sufficiently covered by the outdoor receiver. Also, the mixing or the like is naturally performed without deterioration of the IF signal characteristics.

In the above description, the two bands are provided. It is to be easily understood that the same embodiment may be performed even in two

bands or more.

In the first embodiment of the present invention, a useful low noise converter for satellite broadcasting reception may be provided, which is capable of receiving a plurality of bands by one converter for the converting operation in frequency.

(Second Embodiment)

The second embodiment of the present invention will be fully described with reference to Figs. 3 through 6.

Fig. 5 shows an appearance view of a 2-band LNB1 in accordance with the present invention. Referring to Fig. 5, external terminals are an input waveguide 14 (generally the input terminal is made of a waveguide or may even be made of a coaxial cable) to be connected with an antenna and an IF output terminal 12 only. Accordingly, the airtight construction does not change because of the two bands. Also, the IF output terminal 12 serves as a power supply.

Then, the band switching will be described by use of the circuit diagram of Fig. 3. Referring to Fig. 3, the power supply voltage to be supplied through the IF output terminal 12 is drawn out by a coil L to be supplied to power supply circuit 15. It is divided by resistors R1, R2 to be composed with a reference voltage Vs by a comparator 16, so that the output is inputted to the switching circuit 17 such as relay or the like. As shown in Fig. 6, in the switching circuit 17, a band 1 is selected if the voltage is 12 through 15, a band 2 is selected if the voltage is 16 through 24, with, for example, 15 through 16 in voltage being a threshold voltage (boundary). Also, the power supply circuit 15 is composed of a three-terminal regulator, etc., its inputs, outputs to a radio frequency signal amplification converting portion 18 with the inputs being provided as 12 through 25 V, the outputs P1 through P3 being provided as -3V, 5B, 12V. It is to be noted that C is a capacitor for DC cut use, R3 is a resistor which causes hystesesis characteristics so as to prevent the output of the comparator from being unstable near the threshold voltage.

Also, as shown in Fig. 4, a variable resistor VR is inserted for adjustment in order to prevent the dispersion of the threshold voltage caused by the dispersion of the reference voltage Vs.

According to the second embodiment of the present invention, a useful 2-band LNB is provided which is capable of receiving two frequency bands by one LNB to simplify the construction and to reduce the cost, and also is higher in airtightness to simplify the construction of the LNB itself.

Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

Claims

1. A low noise converter for satellite broadcasting reception use comprising a wide-band low noise amplifier (2), a power divider (7) for dividing the output signals of the amplifier (2) into a plurality of signals, a plurality of band passing type filters (3A, 3B) and mixer circuits (7A, 7B) to be provided correspondingly to each of the divided signals from the power divider (7), and an output selecting circuit (5A/B, 8A/B) for switching to an after-IF amplifier (6) the output signals of the mixer circuits.

2. A two-band low noise converter having an IF signal terminal (12) which serves as a power supply to receive two frequency bands, **characterized in that** means (15 - 17) is provided which changes the frequency band to be received in accordance with the level of the power-supply voltage to be fed through the IF signal terminal.

Fig. 1

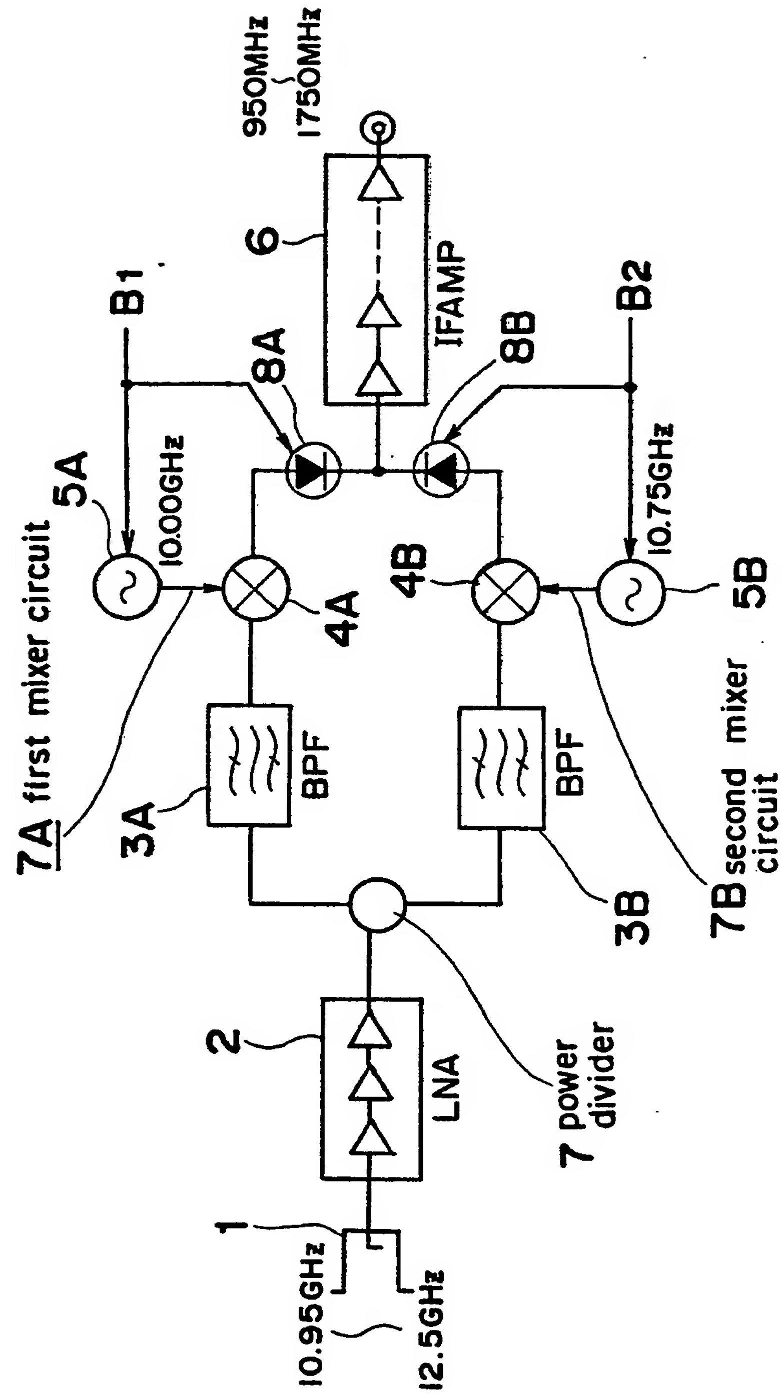

10.95GHz
12.5GHz
1
2
LNA
7 power divider
3A
BPF
3B
BPF
7A first mixer circuit
7B second mixer circuit
4A
4B
5A
10.00GHz
5B
10.75GHz
B1
B2
8A
8B
6
IFAMP
950MHz
1750MHz

Fig. 2

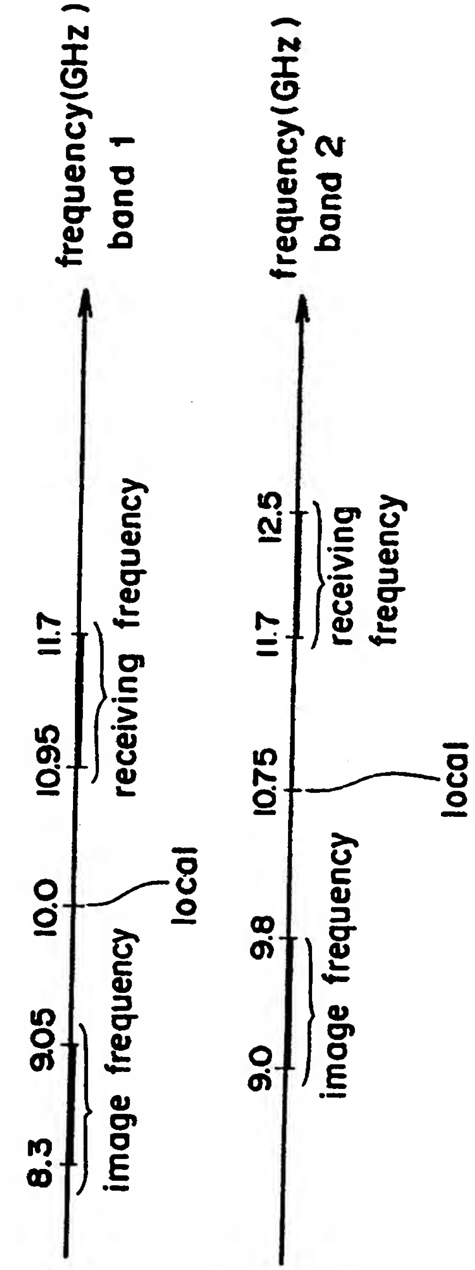

frequency(GHz)
band 1
8.3
9.05
10.0
10.95
11.7
image frequency
local
receiving frequency
frequency(GHz)
band 2
9.0
9.8
10.75
11.7
12.5
image frequency
local
receiving frequency

Fig. 7 PRIOR ART

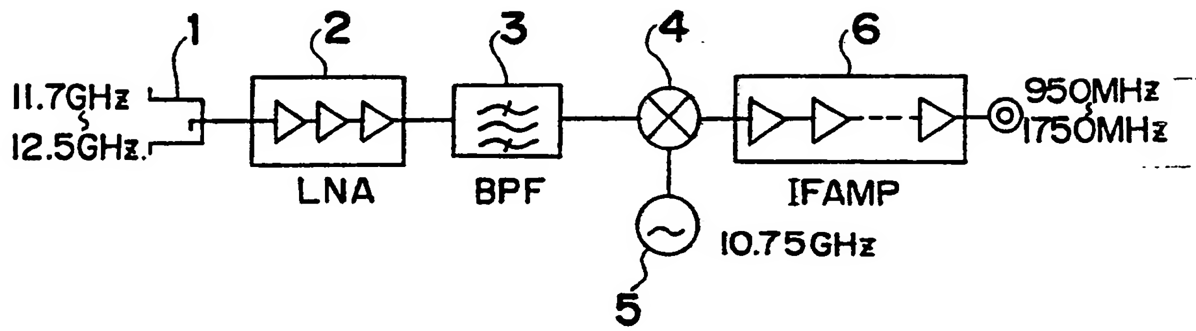


Fig. 8 PRIOR ART

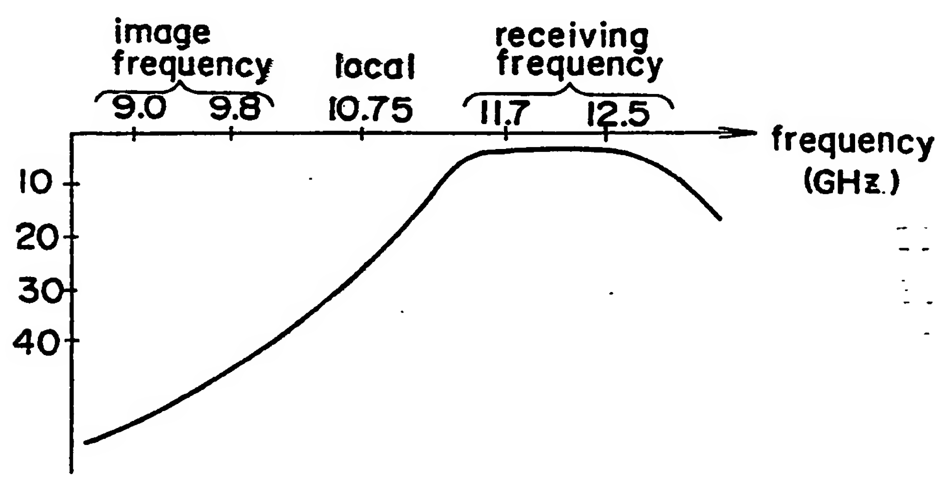


Fig. 3

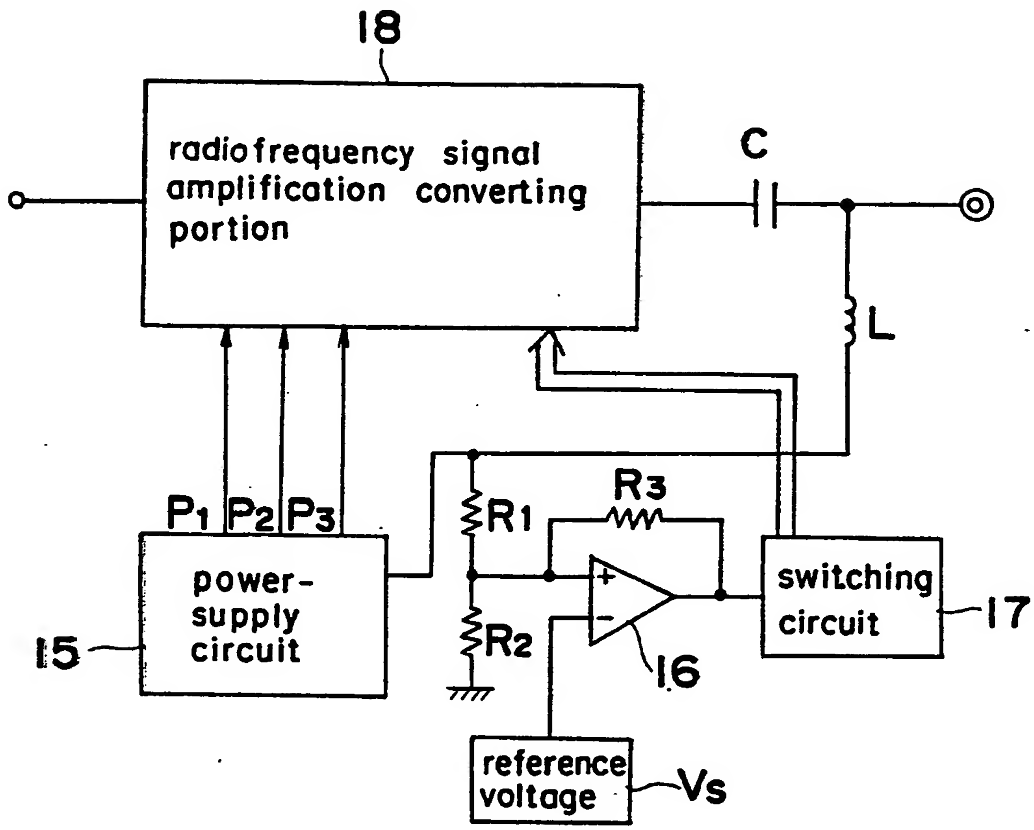

18
radiofrequency signal amplification converting portion
C
L
P1 P2 P3
power-supply circuit
15
R1
R2
R3
16
switching circuit
17
reference voltage
Vs

Fig. 4

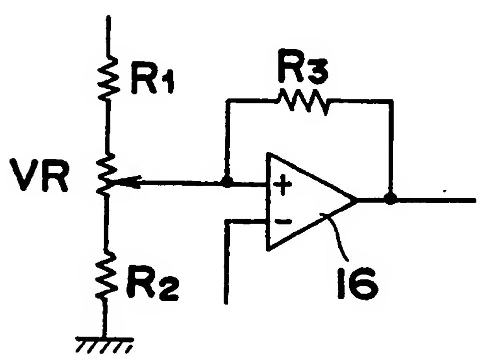

R1
R3
VR
R2
16

Fig. 5

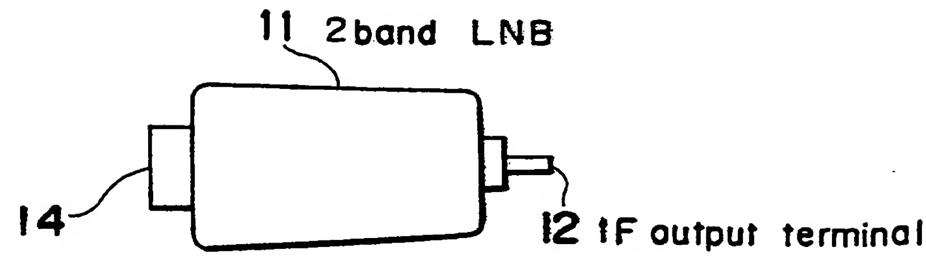


Fig. 6

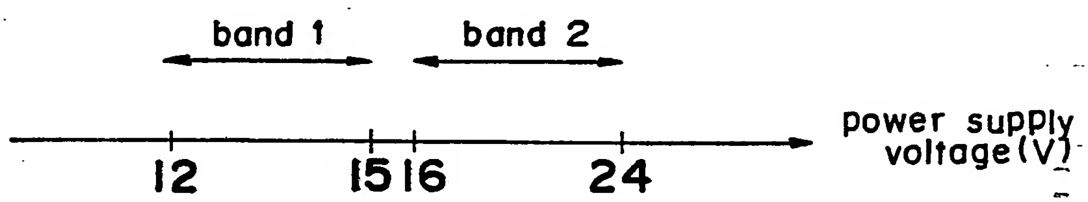


Fig. 9 PRIOR ART